RF Backplane For MTCA.4 Based Control System

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HELMHOLTZ ASSOCIATION

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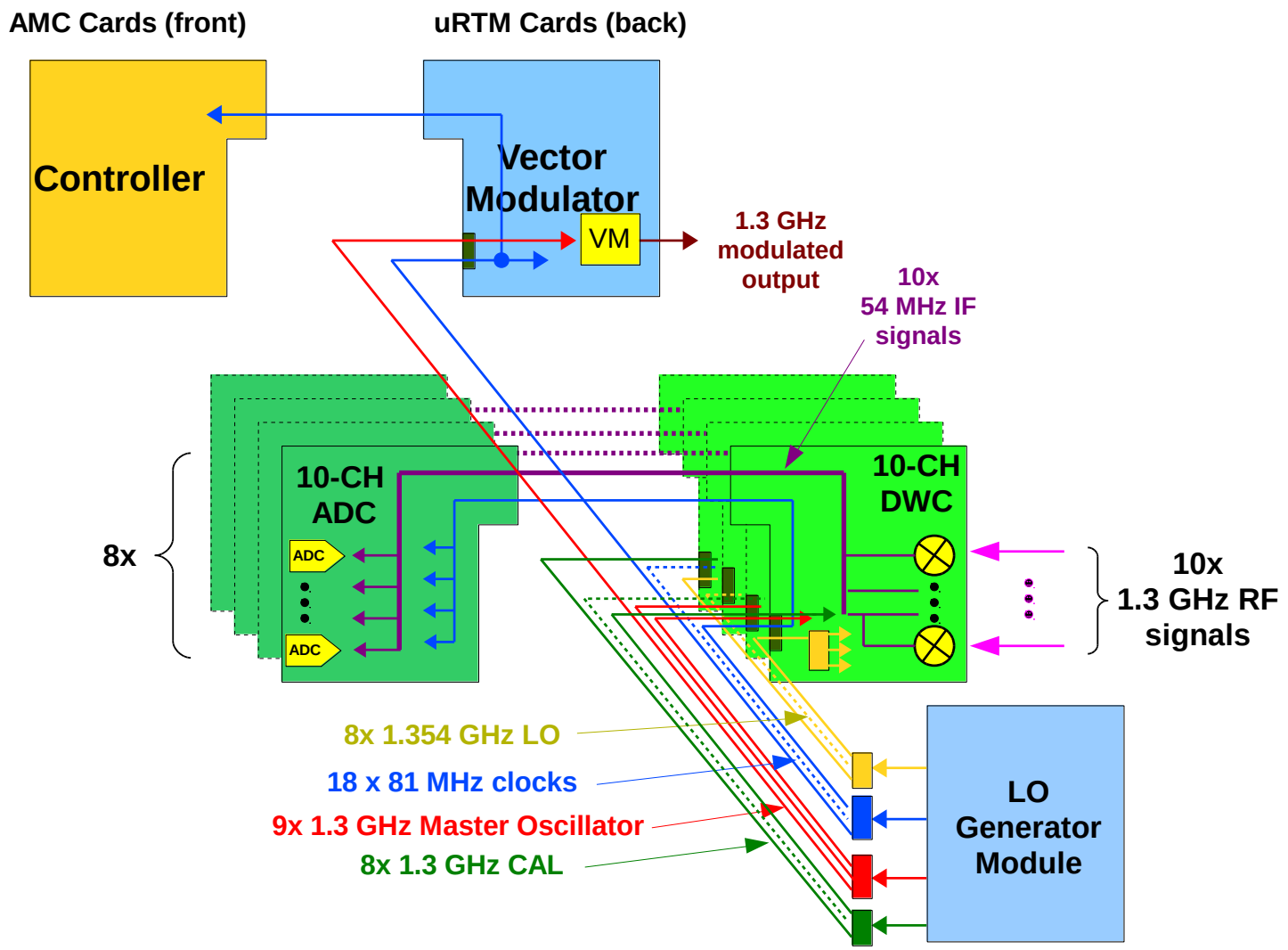
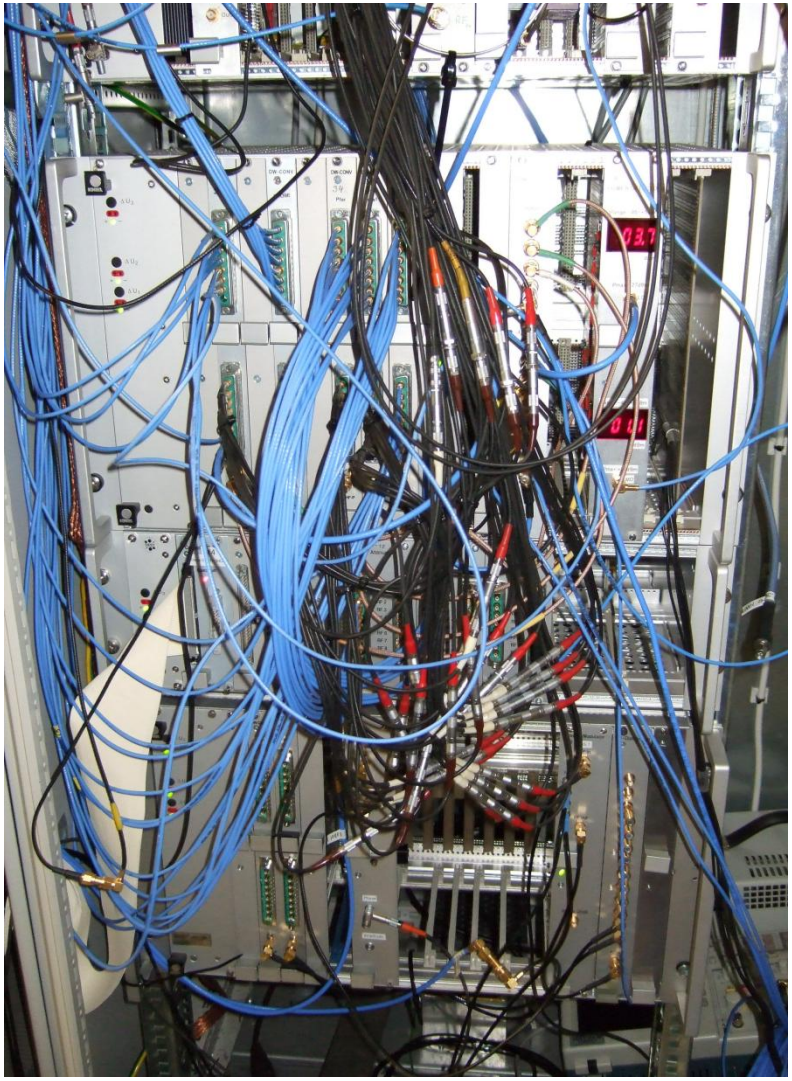
DESY

Internal LLRF System RF Signal Distribution in Fully Equipped MTCA Crate



In Practice Crate Surrounding Would Look Like That…

Cable management is a fundamental problem for many applications

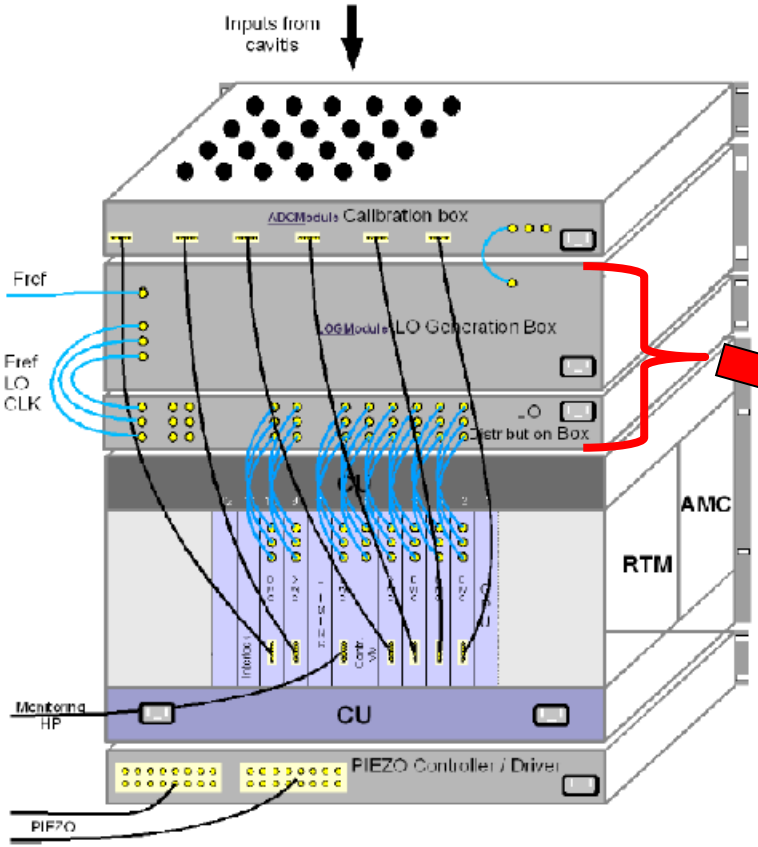


What about hiding „internal” LLRF connections inside of the crate?

RF Backplane Solution

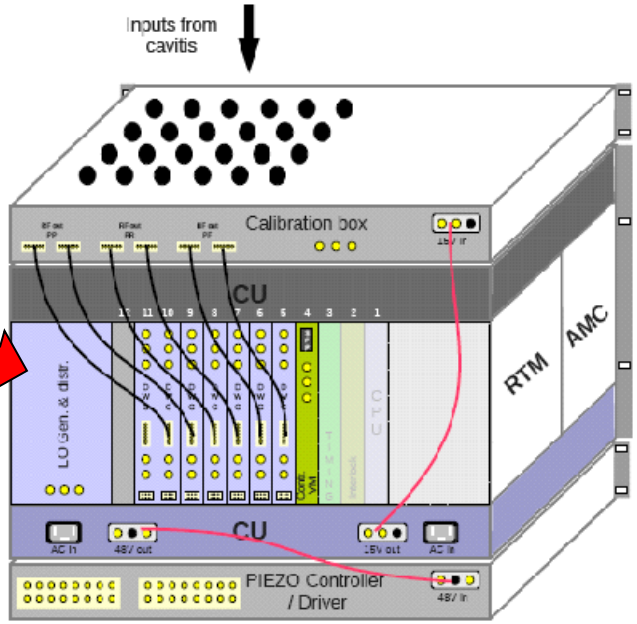
Advantages of the RF Backplane Concept

System with signals distributed outside the crate

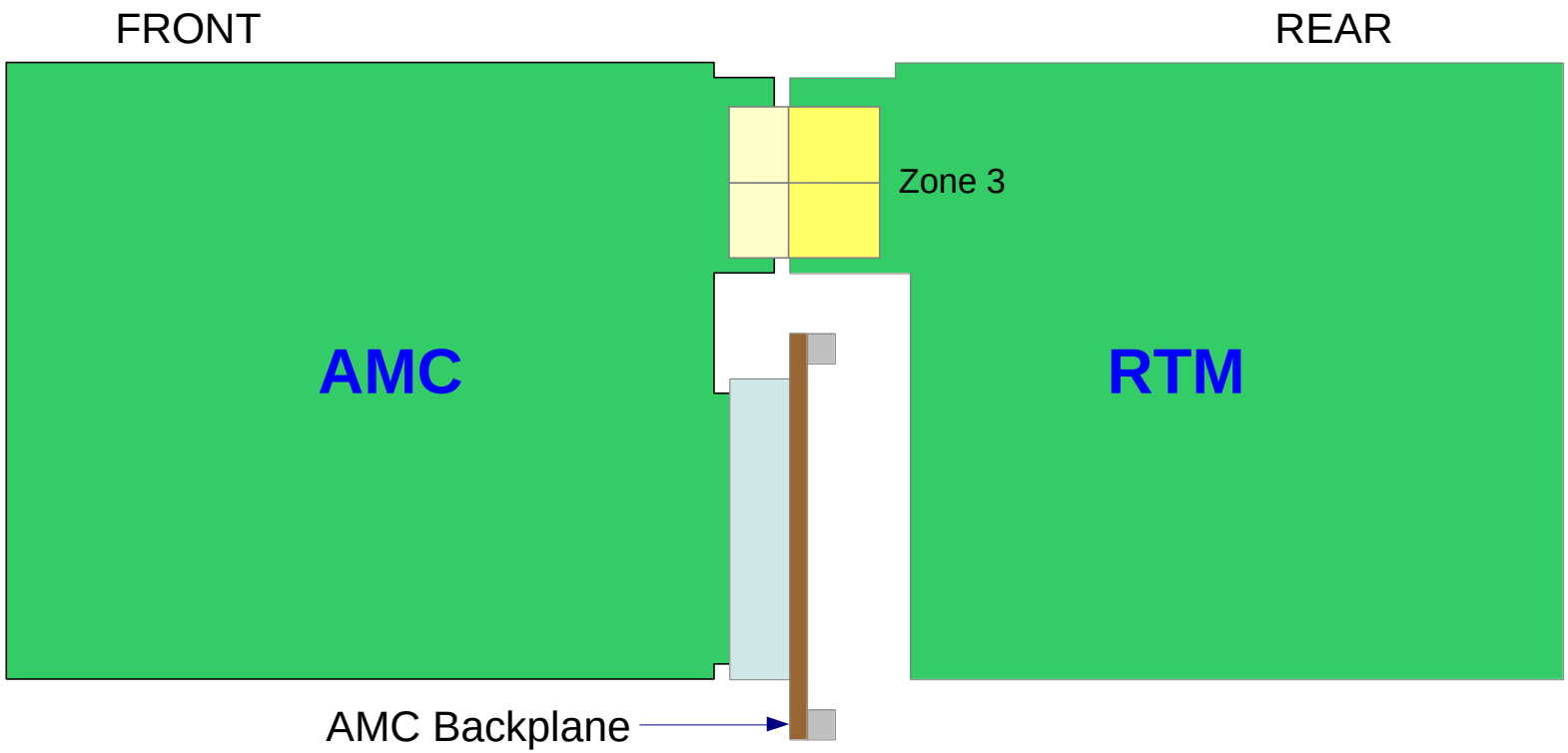


System with RF Backplane

- Improved cable management
- Higher reliability
- Space reduction

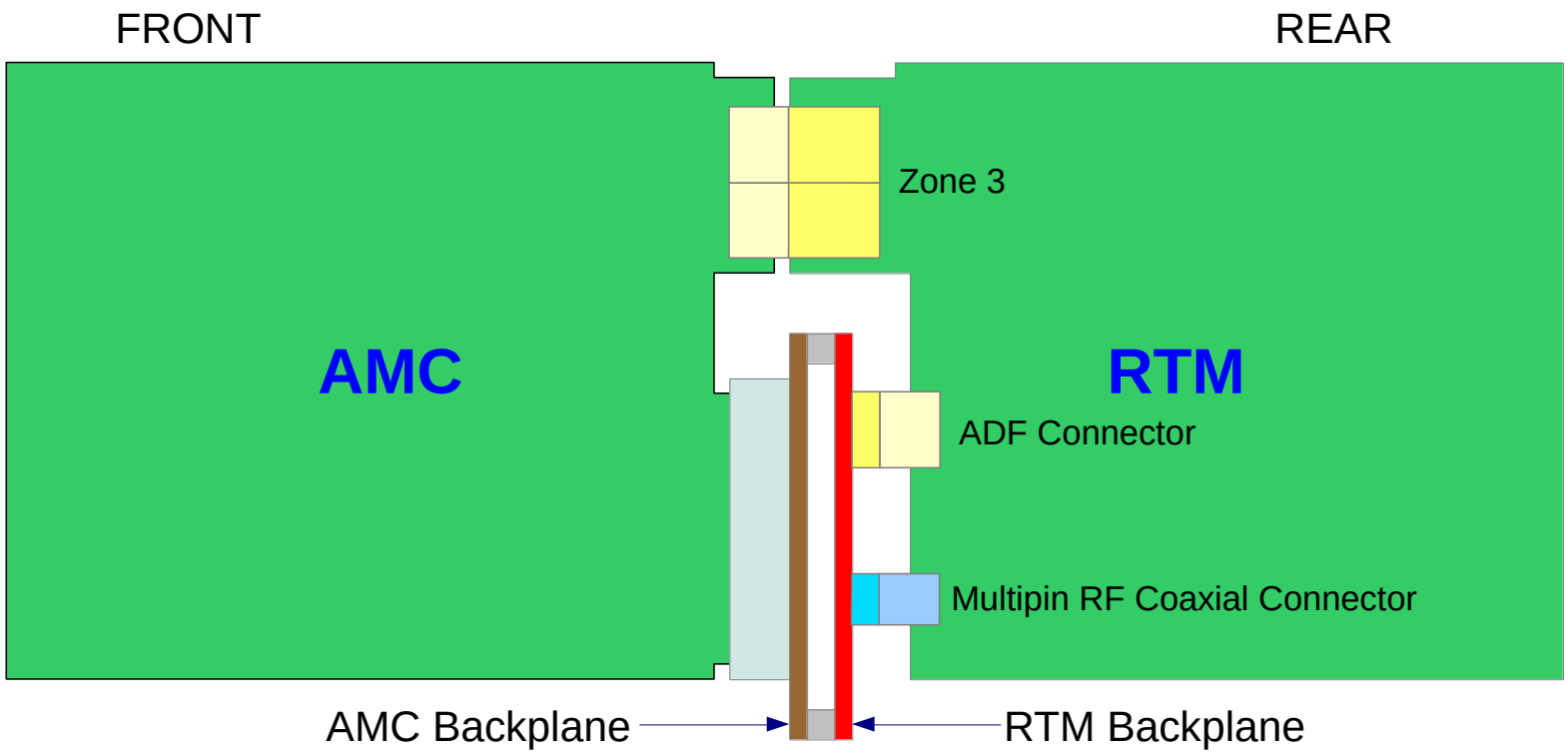


AMC-RTM Pair – Side View



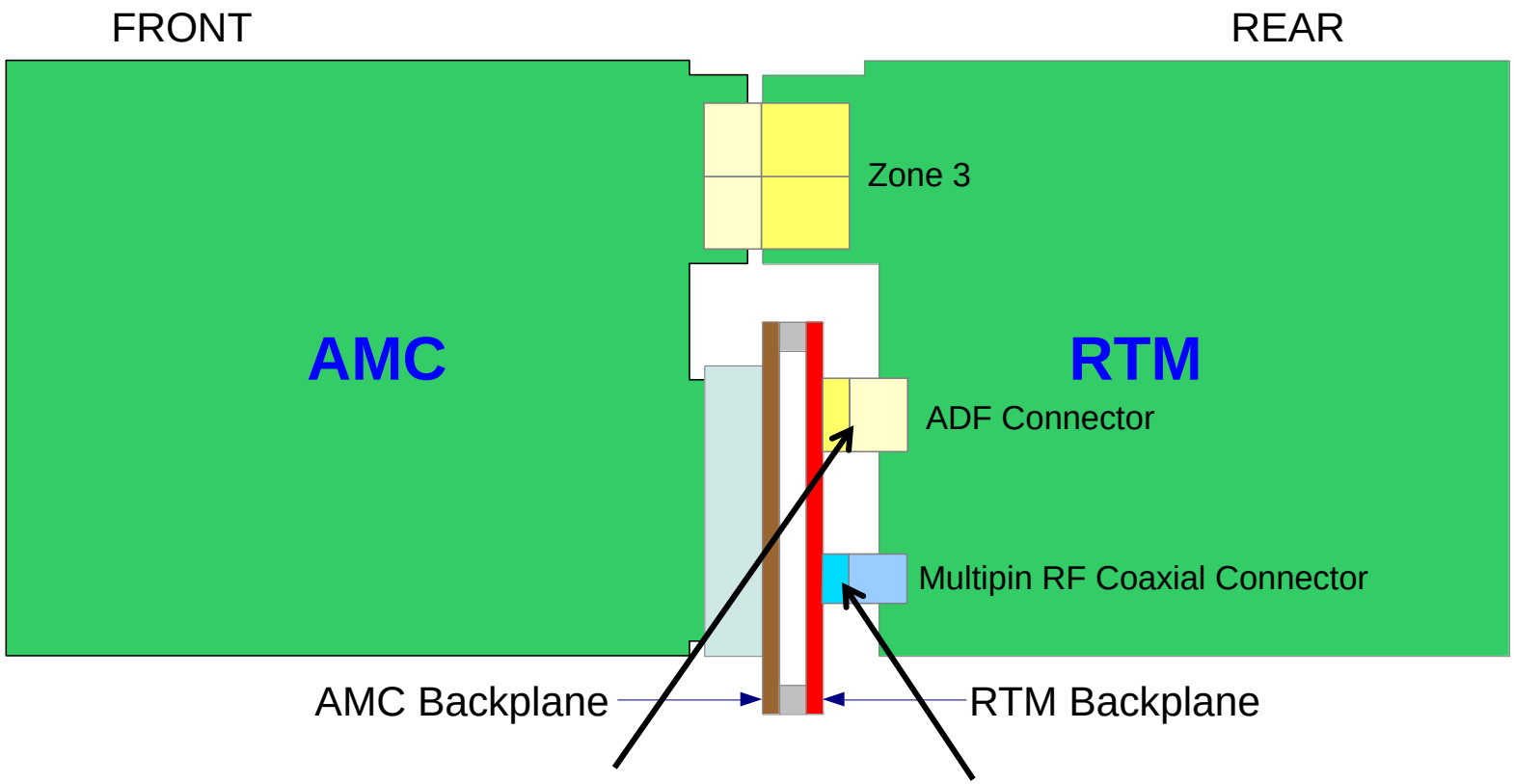
AMC-RTM Pair – RF Backplane Location

Abbreviation **uRFB** - **u**TCA **RF B**ackplane

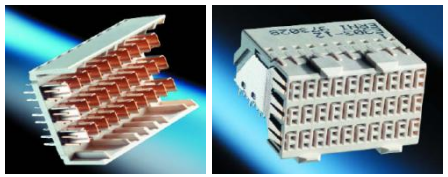


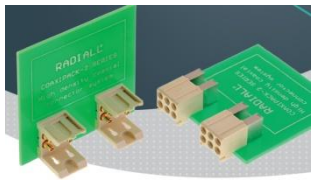
AMC-RTM Pair – RF Backplane Connectors

Abbreviation **uRFB** - **u**TCA **RF B**ackplane



ERMET ZD,
3x10 diff. pairs



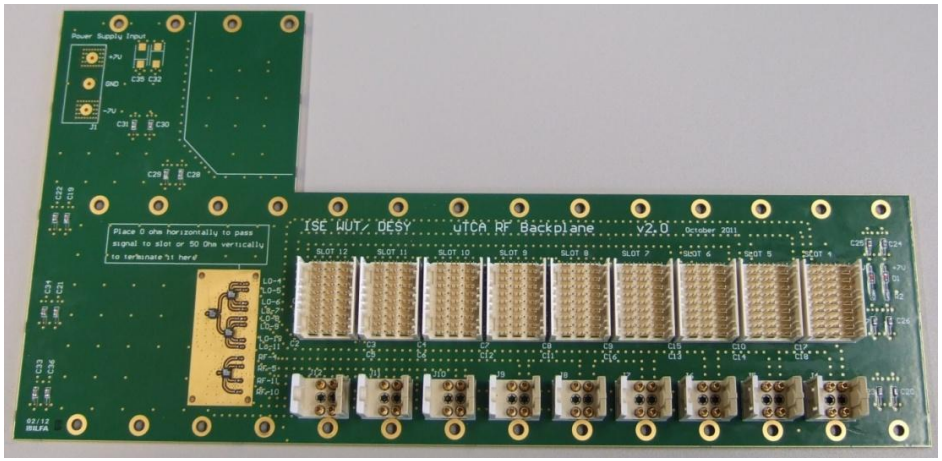


Radiall Coaxipack 2
6-pin, 6GHz RF connectors

Prototype Developments: uRFB v1.0 and v2.0

v1.0 Installed in the crate

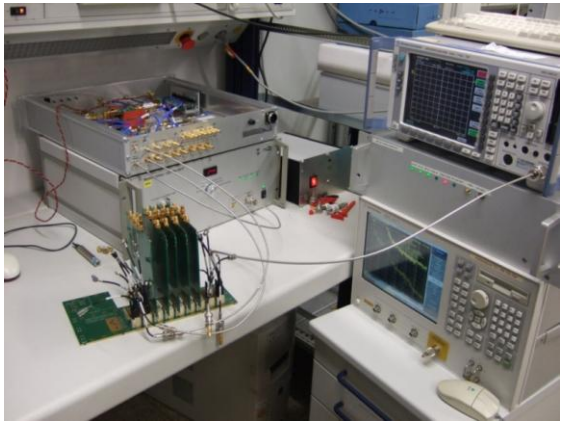
v2.0



- Boards developed to test interconnections and prove feasibility of the uRFB concept
- Fully passive signal distribution

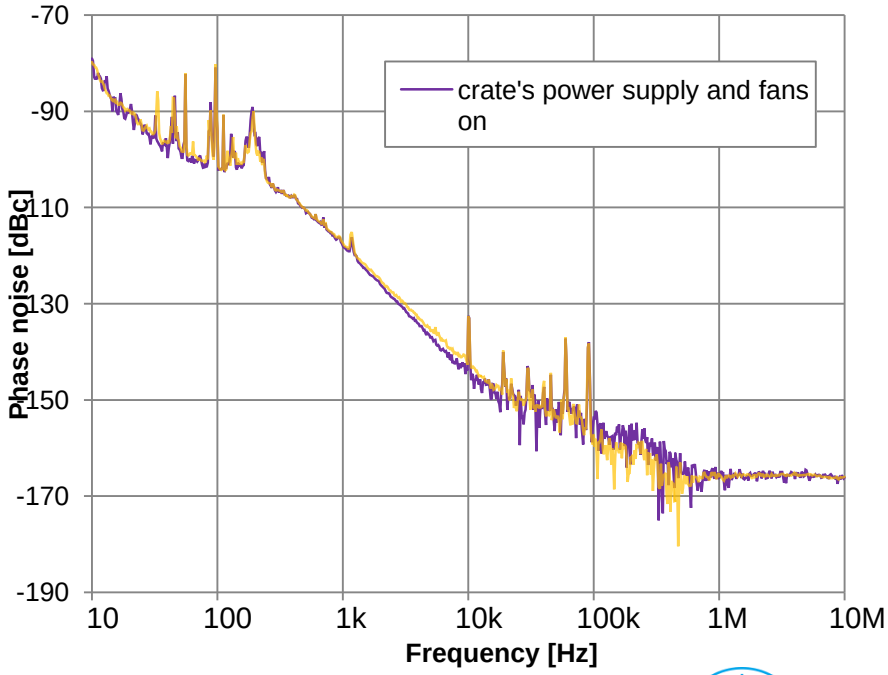
Prototype Board Tests

- Measurements in laboratory and in the crate filled with digital boards



- No detectable signal spectrum degradation – recorded signal spectrum in range 9kHz – 3.5GHz revealed no spectral lines at level above instrument noise floor (-75 dBm)

- Very small influence on phase noise and jitter. Detected jitter degradation of below 10fs (corresponds to below 400μV rms noise in bandwidth10Hz – 10MHz)



- **Proven feasibility of the uRFB concept for LLRF**

uRFB v3.0 – Final Concept Highlights

- **Fully compatible to the standard**. No mechanical collision with standard RTM boards. Supported by crate manufacturers

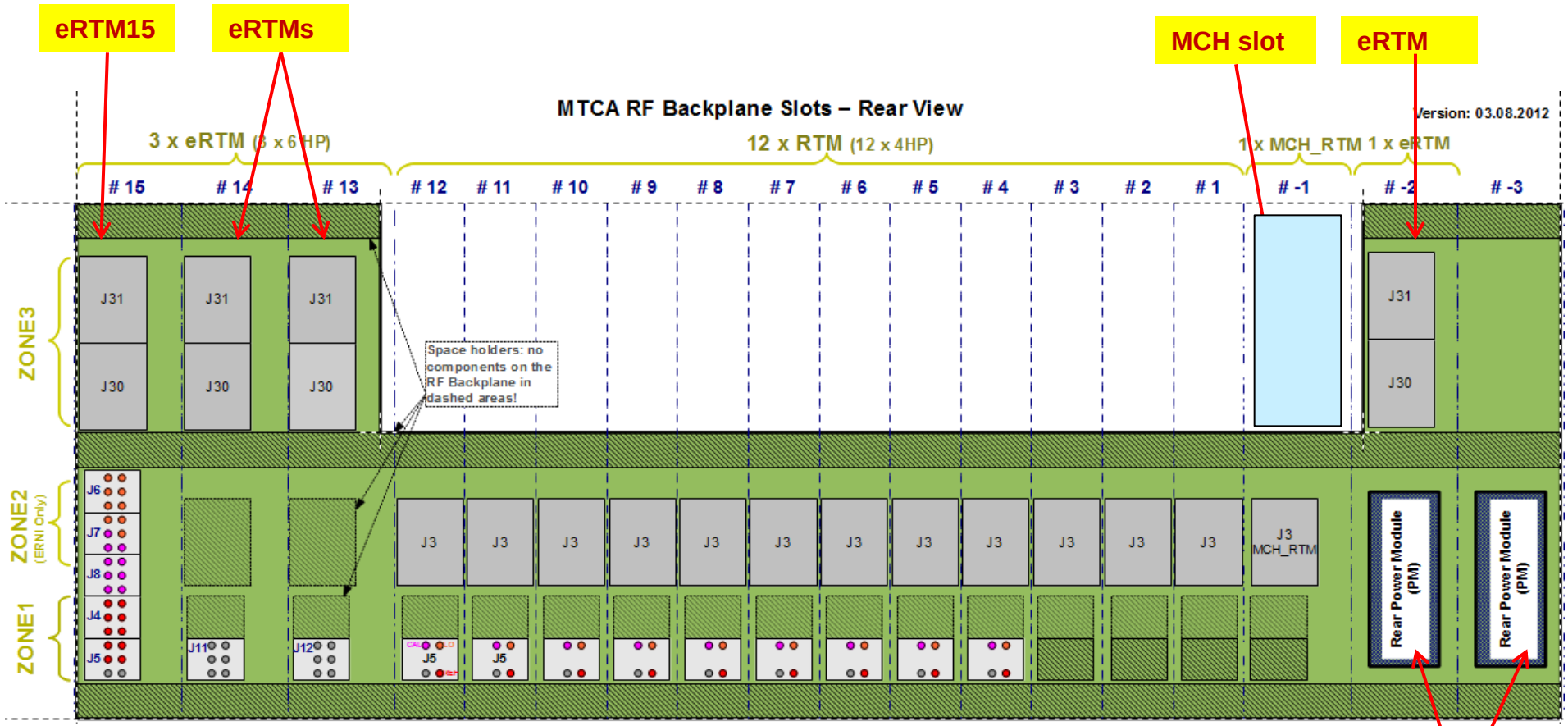
- **Hot plug functionality for RF signals.** IPMI extension for uRFB worked out with N.A.T.

- uRFB fully passive. All intelligence in modules -> great flexibility for users

- Developed a concept of extended RTM (eRTM) boards

- Redundant high performance rear power supply for analog applications

Functionality Extension and eRTM Concept

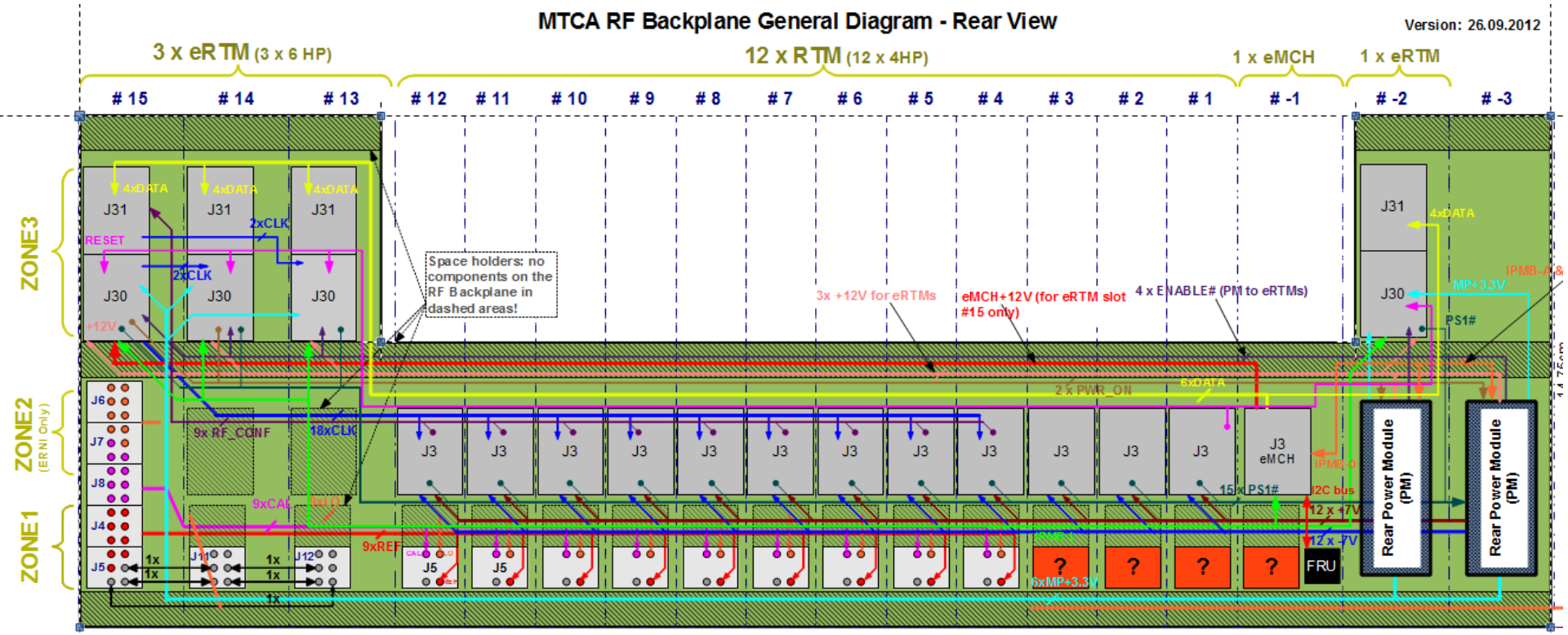


- J30 and J31 mechanically compatible to Zone 3
- Patent pending

Basic Features of uRFB v3.0

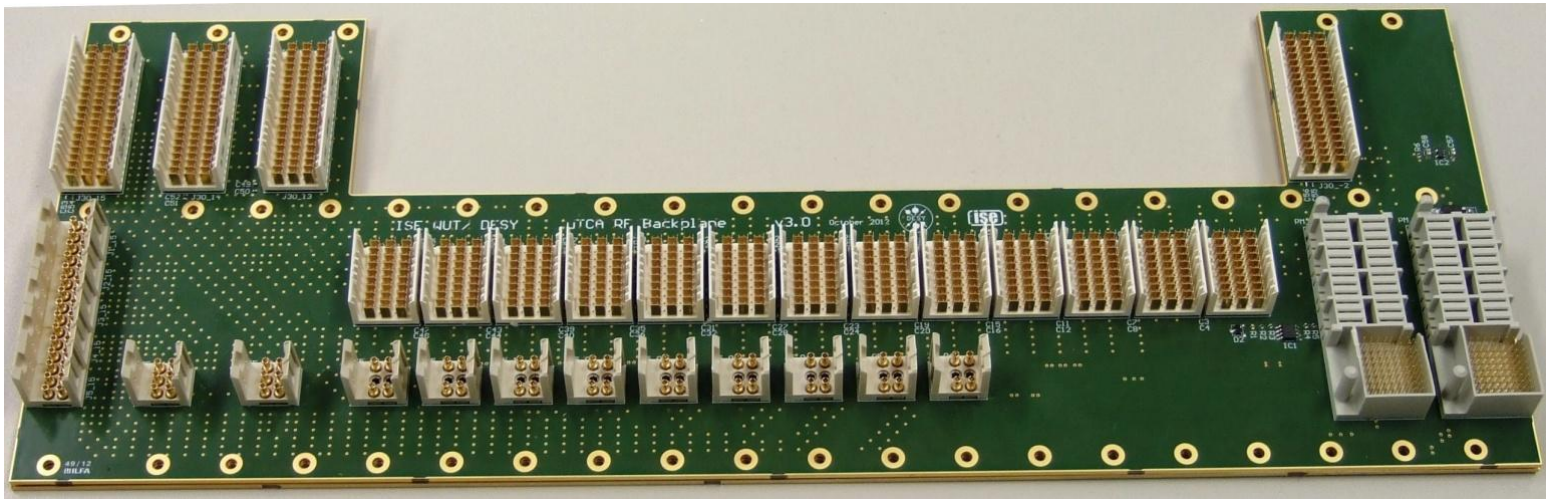
- Supports up to 4 eRTMs (slots 15, 14, 13 and -2)
- Supports up to 9 RTMs
- Support two redundant Rear Power Supply Modules (RPMs)
- Provide managed power supply for RTMs and eRTMs
  - +12V for eRTMs
  - +3.3V MP for eRTMs
  - +/- 7V for RTMs
- Slot 15 for signal entry (uLOG, eRTM15)
  - Min. 22 x CLK signals
  - 9xLO, 9xREF and 9xCAL distribution

uRFB v3.0 Conceptual Diagram

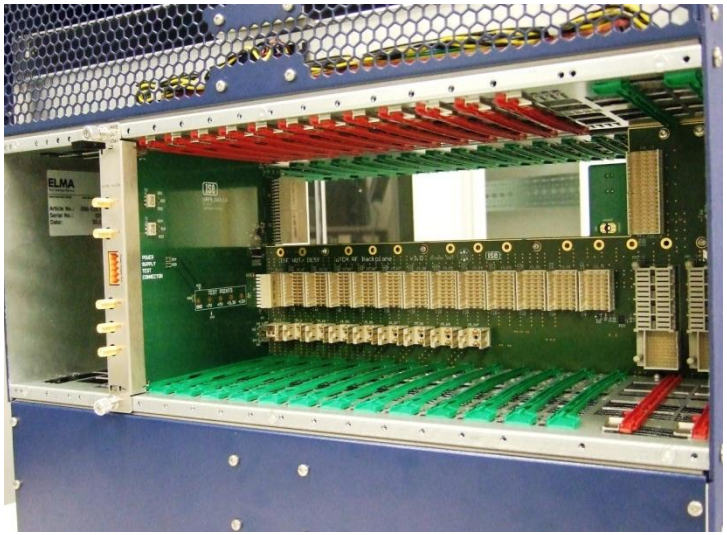


- eRTM15 can be power supplied either by RPMs or by MCH
- Separate power supply for each RTM and eRTM slot

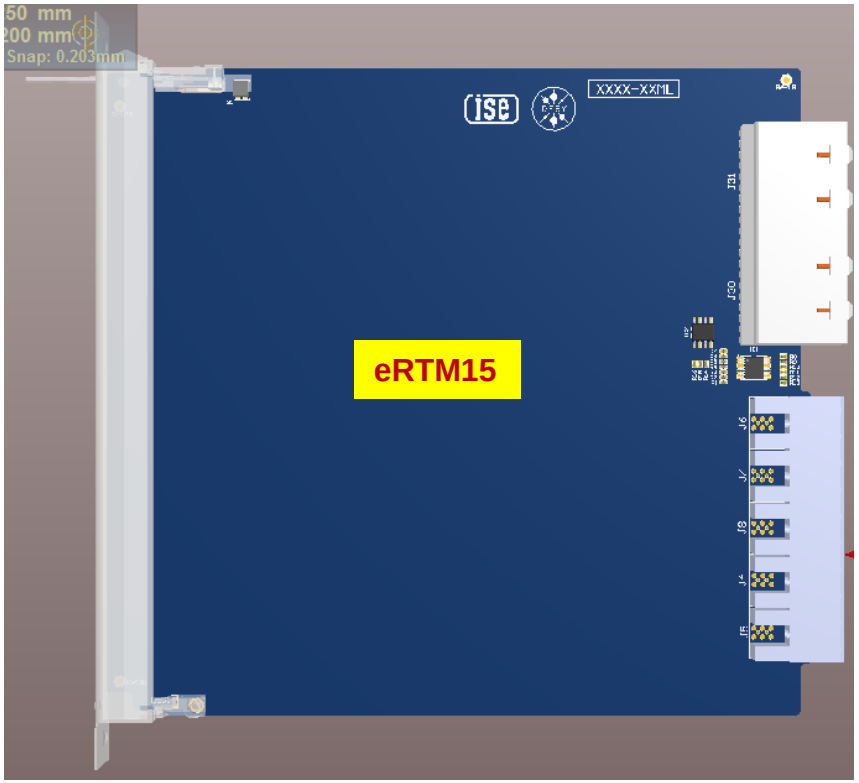
V3.0 PCB Prototype

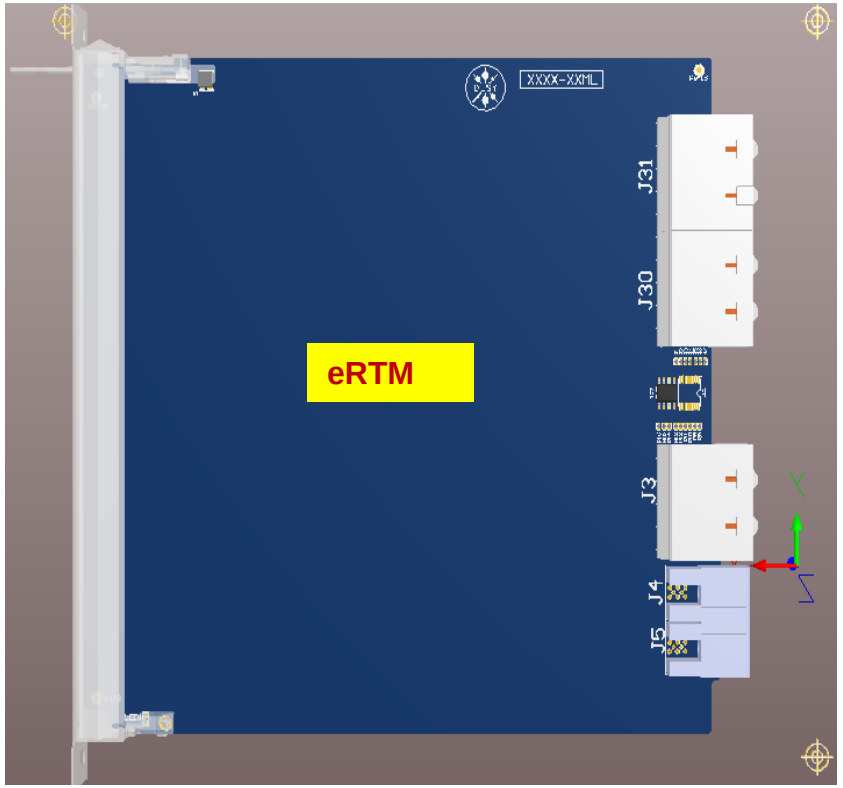


PCB Designer: T. Leśniak, support P. Kownacki



eRTM Templates

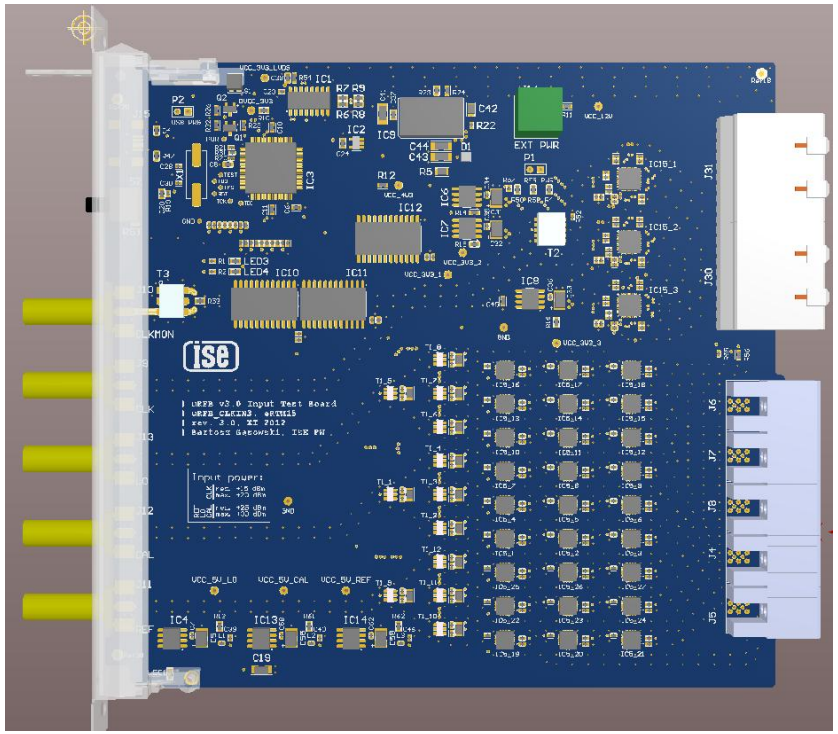




Will be available on the MTCA webpage soon

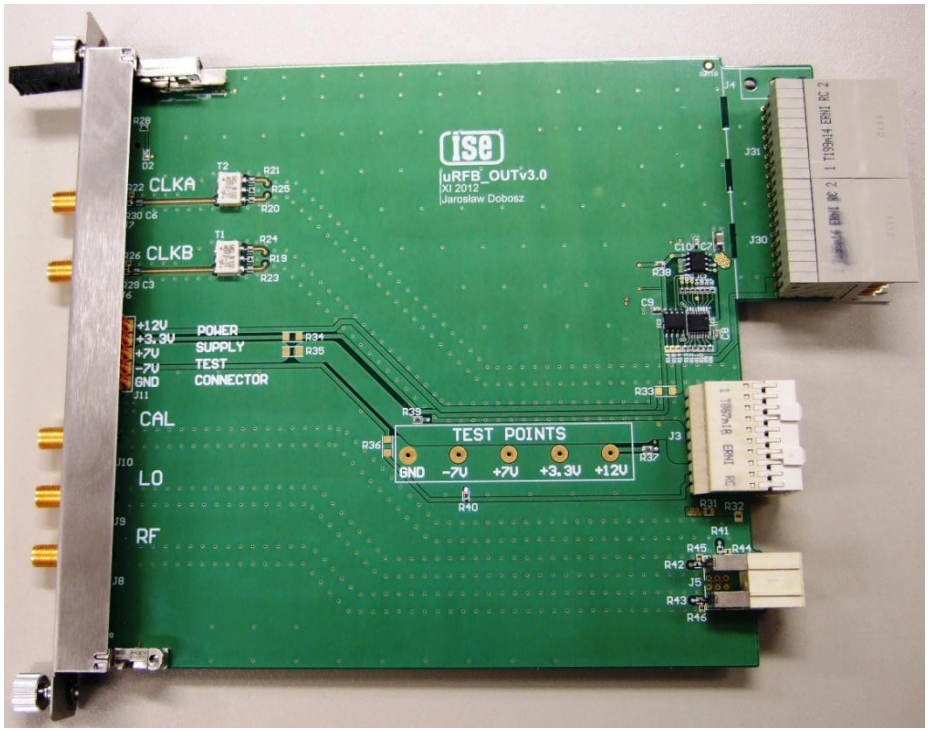
uRFB Test Boards

Input test board (eRTM) – in production



PCB Designer: B. Gąsowski

Output test board (RTM)



PCB Designer: J. Dobosz

Near Future of The RF Backplane

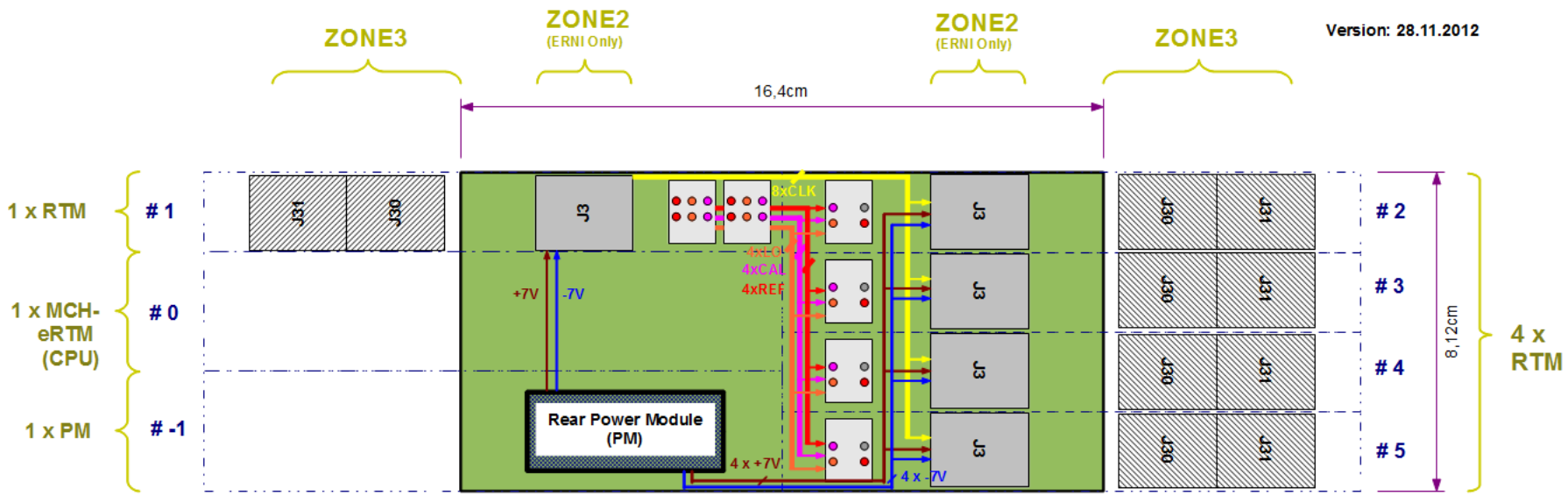
New modules expected soon:

- Input test boards
- MCH_RTM for management
- Rear Power Modules
- uLOG (LO generation module, eRTM)

Many tests are planned like management, signal integrity, EMI and reliability

Performance limits should be evaluated within the HVF

One of the Next Steps: uRFB for Small Form Factor Crates



- Interest and ideas for potential further uRFB applications are welcome

- You are invited for discussion in the BOF part after this session

Thank you for attention!